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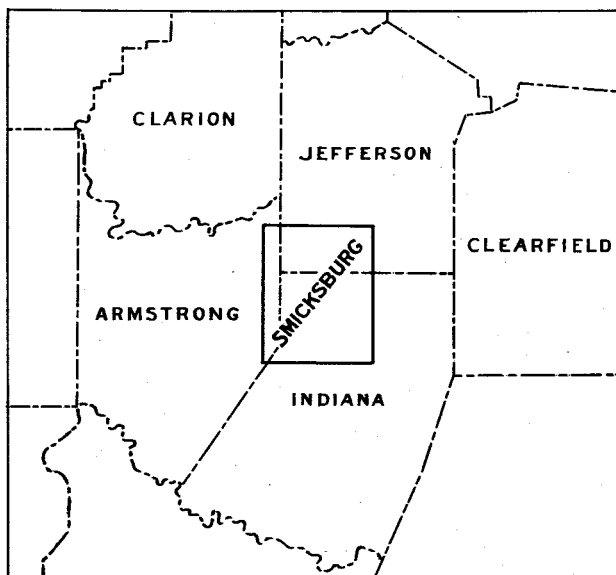
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF INTERNAL AFFAIRS
Thomas A. Logue, Secretary

TOPOGRAPHIC AND GEOLOGIC SURVEY

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STRUCTURE AND STRATIGRAPHY
OF THE
SMICKSBURG QUADRANGLE
(PRELIMINARY REPORT)

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- Figure 1. Geologic structure map of the Smicksburg quadrangle.
- Generalized columnar section of exposed rocks.
- Diagram plotted from well records.

INTRODUCTION

The Smicksburg quadrangle is in the west-central part of Pennsylvania. It occupies parts of northwestern Indiana, southwestern Jefferson, a narrow strip of Armstrong counties, and includes an area of 225.9 square miles that extends from latitude north $41^{\circ}00'$ to $41^{\circ}15'$ and from longitude west $79^{\circ}00'$ to $79^{\circ}15'$. It is bounded on the north, east, south and west by the Brookville, Punxsutawney, Indiana and Rural Valley quadrangles.

A detailed survey of the geology and mineral resources was begun in the summer of 1936, and, although the field work is not completed, and the data obtained thus far have not been thoroughly studied, enough work has been performed to warrant the issuance of a preliminary description and structure map. The accompanying structure map, contoured at intervals of 50 feet on the top of the Upper Freeport coal, is somewhat generalized, but it is believed to be essentially correct, and it is expected that the final map, which will probably be contoured at 25-foot intervals, will differ only in detail.

The maps, text and stratigraphic sections will in the meantime be in course of preparation for the final report and may be consulted at the offices of the Topographic and Geologic Survey at Harrisburg.

PHYSIOGRAPHY

The Smicksburg quadrangle lies within the Pittsburgh section of the Appalachian plateaus province. The topography is of two types: the upland surface is a broad dissected plateau approximately mature, with sinuous hills sloping at varying degrees, depending upon the character of the underlying rocks, being nearly flat-topped where underlain by sandstone, and rounded where underlain by shale; the hilltops range from 1,400 feet to a little more than 1,800 feet above sea level. The lowest point in the quadrangle, contoured at 1,060 feet, is in the gorge of Mahoning Creek northwest of Milton where the creek leaves the quadrangle. The highest point is a hilltop contoured at 1,840 feet, about one mile northwest of Grange.

The streams have cut steep-sided valleys, their slope being also controlled by the relative hardness of the rocks. Northwest of Milton, where Mahoning Creek has cut its channel through hard sandstones, the valley walls are nearly precipitous. Nearly all the quadrangle is drained by Mahoning and Little Mahoning creeks and their tributaries, which flow generally westward into the Allegheny River. A small area in the southwestern part is drained by the north and south branches of Plum Creek and Cowanshannock Creek, which flow southwestward and eventually into the Allegheny River.

STRUCTURE

The rocks of the Smicksburg quadrangle have been folded into a series of gentle, roughly parallel anticlines and synclines. The axes are sinuous and some are discontinuous; their general trend is northeast-southwest. The area in the southwestern part of the quadrangle north of Sagamore appears to be a warped surface with a gentle dip southwestward.

Although the major streams have maintained their courses regardless of the structure, there appears to be some relationship between the structure and the topography, the hilltops on the anticlines being generally higher than those on the synclines. On and near the dome on the Sprankle Mills anticline northwest of Grange, a few hilltops rise above 1,800 feet which is approximately 200 feet higher than the hilltops on the adjacent synclines. The axis of the Richmond anticline southeast of Marion Center, raises a few hilltops to 1,800 feet, whereas hilltops on the adjacent syncline rise above 1,600 feet, and average much lower.

The major structural axes from northwest to southeast are as follows: North Freedom anticline, Worthville syncline, Sprankle Mills anticline, Punxsutawney syncline, Roaring Run anticline, Elders Ridge syncline and Richmond anticline.

North Freedom anticline.

A small part of the southwestern end of the North Freedom axis is in the Smicksburg quadrangle. It crosses the northwest corner of the quadrangle, passing just north of New Salem. It is actually the southwestern plunge of a dome which is well developed in the Brookville quadrangle and disappears in the Rural Valley quadrangle.

Worthville syncline.

As continued from the Brookville quadrangle, the Worthville syncline is the southwestern end of an almost symmetrical basin, the axis of which enters the Smicksburg quadrangle half a mile west of Ringgold, and, trending southwestward, it rises about 40 feet per mile to a point along Pine Run three-quarters of a mile west of Timblin. From this point it perhaps turns directly westward along Pine Run, leaving the quadrangle through the 1,500-foot structure contour, but data are lacking at this time to justify this projection.

Sprinkle Mills anticline.

The best developed structure in the quadrangle is the Sprinkle Mills anticline. It was named after that place in the Brookville quadrangle near which it passes. Continuing into the Brookville and Rural Valley quadrangles, the axis is sinuous, rising and falling in a series of domes and saddles. Entering the Smicksburg quadrangle at the north, half a mile east of where Big Run leaves the quadrangle, it trends southwestward, rising to a dome at the boundaries of Ringgold, Oliver and Perry townships. From there it turns more to the west, falling about 30 feet per mile, to a slight saddle a little northeast of the place where the axis crosses the Nye Branch of Pine Run. It then continues directly southwest, rising to a narrow-crested dome, which follows the axis across the gorge in Mahoning Creek one mile northwest of Milton, and leaves the quadrangle $1\frac{1}{4}$ miles west of Milton.

The northern flank is fairly regular and rises about 125 feet per mile. The southern flank is longer, rising variously from 25 to 300 feet per mile and is very irregular with many spurs and re-entrants. The spur just east of Hamilton running northeast through Frostburg was formerly mapped as a separate anticline.

Punxsutawney syncline.

The axis of the Punxsutawney syncline appears on the eastern border of the Smicksburg quadrangle, about one mile south of the western edge of Punxsutawney. Trending southwestward, it crosses the edge of a bend in Mahoning Creek at Sportsburg. About half a mile southwest of Sportsburg there is a flexure more to

the westward. From there it continues in a nearly straight line, crossing Dutch and Crossman runs to a point three-quarters of a mile north of Trade City along the Hamilton-Trade City road. From this point westward to Smicksburg structural data are poor but there seem to be indications of flattening.

Roaring Run anticline.

An anticline enters the Smicksburg quadrangle a little north of the center of the eastern border, one mile east of Cavode, which has been named Roaring Run anticline because of its apparent continuation from that structure in the Indiana quadrangle. The axis is curved, the general trend being northeast-southwest, but varies from due east-west to nearly north-south.

The southwestern part of this anticline, if considered comparatively, might be referred to as a re-entrant to the warped surface north of Sagamore. From a dome just over the east border in the Punxsutawney quadrangle the axis descends gradually southwestward, passing half a mile to the south of Cavode, and crossing Mudlick Run; it there turns westward to a low just north of Trade City station. Turning sharply southwestward at this point, it climbs to a narrow-crested dome of small extent, which lies across a meander of Little Mahoning Creek north of McCormick. Recrossing Little Mahoning Creek it plunges regularly as a nose at the rate of 25 feet per mile through Sharpsburg to a low one mile south of the boundary of Washington Township. There, turning more to the south, it leaves the quadrangle, rising to a dome in the Indiana quadrangle.

Elders Ridge syncline.

The Elders Ridge syncline, as it occurs within the Smicksburg quadrangle, could also be included as a broad nose of the warped surface described above. Regionally, however, it is the northern end of a syncline that continues southwestward for more than 50 miles. The axis enters the southern part of the quadrangle between Reddens Run and South Branch of Plum Creek. Trending northeastward, it flexes more to the east as it crosses Benson Run. Continuing north and east of Elkin in a wide curve it rises 20 feet per mile to half a mile west of Mottarns Mill, where the axis was arbitrarily terminated.

Owing to some doubtful correlations, the structural control of the southeastern flank is somewhat questionable, hence the broken contour lines.

Richmond anticline.

One and one-half miles of the Richmond anticlinal axis crosses the southeast corner of the quadrangle. It plunges at the rate of approximately 150 feet per mile southwestward into the Indiana quadrangle, where it soon flattens out. Traced into the Punxsutawney quadrangle, it rises to a dome contoured at 1,850 feet, likewise on the Upper Freeport coal.

The northwestern flank rises from the axis of the Elders Ridge syncline, beginning at the rate of 50 feet per mile, and increasing to a maximum of 175 feet per mile as it approaches the axis. This structure in the Punxsutawney quadrangle appears to be a spur of Chestnut Ridge anticline, which has been traced 150 miles from the Maryland line to north-central Pennsylvania.

Faulting.

With the exception of some slight local disturbances, no faulting was observed in the quadrangle. The term "fault" as used by a coal miner means that an overlying sandstone has cut down into the coal bed, reducing its thickness or cutting out the coal entirely. This is an erosional and sedimentary feature and is not caused by tectonic disturbance.

STRATIGRAPHY.

A total thickness of about 1,000 feet of rocks is exposed in the Smicksburg quadrangle, and about 6,000 feet of the underlying rocks have been penetrated by the drill in search for natural gas. All of the rocks are sedimentary in origin, consisting of shale, sandstone, conglomerate, limestone, coal and clay, shale and sandstone predominating. All are stratified, grading from coarse sandstones which are locally conglomeratic, to fissile shales. Unconsolidated silt, sand and gravel occur on the flood plains of the larger streams.

All of the solidified rocks are Carboniferous in age, and are included in the Pennsylvanian and Mississippian systems. For convenience of study and mapping the Pennsylvanian system has been subdivided into two series, the Pottsville and the Pittsburgh, and the latter is divided into the Allegheny, Conemaugh and Monongahela groups, in ascending order.

Although all of the rocks are stratified, detailed studies in western Pennsylvania have shown the stratification to be very variable due to irregularities of deposition. In deciphering the geology this is very confusing. Massive sandstone may, within a short distance, become thin-bedded and shaly or grade into shale; and definite key rocks, such as coal and limestone, may have their places occupied by other materials.

In preparing the accompanying generalized stratigraphic column of exposed rocks, an attempt was made to show this variability.

Distribution.

The Monongahela and the upper part of the Conemaugh groups have been eroded. The lower part of the Conemaugh is represented throughout practically all of the quadrangle. Remnants of the lowest members occupy the higher land in the northern part. Excluding the valley of Little Mahoning Creek, an area in the southeastern corner, and a very small area in the southwestern corner at Sagamore, the Conemaugh rocks underlie all of the central and southern parts of the quadrangle.

The Allegheny group has its greatest distribution in the northern part of the quadrangle. The entire thickness of 330-350 feet is exposed in the vicinity of Milton and north of Grange. The upper members occupy the valley of Little Mahoning Creek in the central part. The Richmond anticline raises most of it above drainage in the southeastern corner, and in the southwestern corner at Sagamore the Upper Freeport coal crops out for a distance just above drainage along North Branch of Plum Creek.

The Pottsville is limited to two small areas. The upper part is exposed at the northern boundary of the quadrangle, where the axis of the Sprinkle Mills anticline enters. A little southwest of Milton the top of the group appears in Mahoning Creek. Rising northwestward in the gorge, the Sprinkle Mills anticline brings all of the group well above drainage.

The upper part of the Pocono is, very probably, exposed in the gorge northwest of Milton.

Description of groups.

Conemaugh group.

In western Pennsylvania the Conemaugh group extends from the base of the clay underlying the Pittsburgh coal, down to the top of the Upper Freeport coal. Only the lower part of this group is represented in the quadrangle, the upper part having been removed by erosion. The total remaining thickness is about 500 feet, consisting chiefly of shales, local massive sandstones, and several coal beds that are generally thin and economically unimportant, but serve as stratigraphic markers. The important members are:

	Average distance above Upper Freeport coal
	Feet
Duquesne coal	370
Ames limestone	325
Harlem coal	310
Upper Saltsburg sandstone	---
Upper Bakerstown coal	260
Woods Run limestone	245
Lower Saltsburg sandstone	---
Lower Bakerstown coal	195
Pine Creek limestone	175
Buffalo sandstone	---
Brush Creek coals and limestone .	95
Upper Mahoning sandstone	---
Mahoning coal and limestone . . .	45
Lower Mahoning sandstone	---

The Duquesne coal is the highest stratigraphic member observed in the quadrangle. It was seen only as a blossom at outcrop. The Harlem and Upper and Lower Bakerstown coals have been mined locally but rarely exceed two feet in thickness. Two thin coals were noted at the Brush Creek horizon, about ten feet of dark shales separating them. The Mahoning coal, generally absent, was found only as a bloom in just a few places.

The Ames limestone with its typically greenish-gray color and abundance of marine fossils, is exposed in several road cuts. It is, stratigraphically, the highest marine limestone in western Pennsylvania. The maximum observed thickness in this area is 17 inches. Red shales occur above and below and are useful in locating its position. The Woods Run limestone has been quarried in the vicinity of Cavode. It is sparsely fossiliferous (marine), and four feet thick. Few outcrops were found, but red shales associated with the horizon make it possible to locate its position. Nodules and much weathered outcrops of the Pine Creek limestone were seen in a few road cuts. It is reported to contain marine fossils in other areas. The Brush Creek limestone is easily recognized by its grayish-black color and the marine fossils in the calcareous shales on top. It lies just under the upper coal and is associated with a variable thickness of dark to black fissile shales. The interval from the Upper Freeport coal to the Brush Creek limestone ranges from 60 to 135 feet. A light and red plastic clay usually marks the horizon of the marine Mahoning limestone where present. Unweathered limestone was found at only one place.

The sandstones of the lower part of the Conemaugh group appear lenticular with local variations. They vary in mode of deposition, thickness, texture and color, making it difficult to distinguish them lithologically. They are, therefore, uncertain stratigraphic markers.

Allegheny group.

This group includes the strata between the top of the Upper Freeport coal and the base of the clay underlying the Brookville coal. The thickness varies from 330 to 370 feet. Seven coal beds are included in the group, three of which are of economic importance, and mined locally. The others have been mined for local consumption only. The most important members are:

	Average distance below Upper Freeport coal
	Feet
Upper Freeport coal	--
Upper Freeport limestone	10
Lower Freeport coal	50
Upper Kittanning coal	110
Middle Kittanning coal	160
Lower Kittanning coal	230
Vanport limestone	260
Clarion coals	300
Brookville coal	350

Although thin, and lacking in places, the Upper Freeport coal averages four feet in thickness. It is persistent and of fairly uniform thickness in the northwestern part of the quadrangle where it was formerly mined commercially. These operations were abandoned chiefly because of "faults" and not because the coal was mined out. The Buffalo & Susquehanna Coal Company has extensive operations on the Upper Freeport coal at Sagamore. Many custom banks are working it along its outcrop. The Upper Freeport limestone, where present, lies from one to 20 feet below the Upper Freeport coal. It ranges in thickness up to 15 feet. The farmers quarry and mine it for agricultural purposes. This was the most important key bed in mapping the geology. The Lower Freeport coal is mineable and persistent in the northeastern part of the quadrangle. It averages about 3 feet in thickness. It was formerly mined extensively in the vicinity of Punxsutawney, where it was noted for its excellent coking qualities. Many country banks are now working it. The Upper Kittanning coal is generally too thin to be mined but a country bank opened on it a little southeast of New Salem disclosed 9 feet of coal, the upper $4\frac{1}{2}$ feet of which is cannel coal. The most persistent coal in the quadrangle is the Lower Kittanning, averaging about 3 feet. Several commercial mines and many country banks are working it in the northwestern part of the quadrangle. The Vanport marine limestone is an important key bed in the northwestern part of the quadrangle because it can be recognized by the abundance of fossils. The farmers quarry and calcine it for local use. It averages 3 feet in thickness. The Clarion and Brookville coals are not of mineable thickness.

Pottsville series.

The boundaries of the Pottsville series in the western part of the State are the base of the clay underlying the Brookville coal and the top of the Mauch Chunk red shales or older Mississippian strata where the Mauch Chunk is missing. The Homewood sandstone, Mercer shales and the top of the Connoquenessing sandstone members are exposed in the gorge of Mahoning Creek. Probably the whole thickness is above the creek, but because of the tremendous quantity of boulders that cover the valley walls, the base could not be found. Detailed work in the Brookville* quadrangle has shown that the Mauch Chunk and the top of the Pocono have been eroded from

* Graeber, C. K., Structure and Stratigraphy of the Brookville Quadrangle: Pennsylvania Geological Survey, Bull. 120, 1938.

that area. Therefore the Pottsville lies unconformably on the Burgoon sandstone member of the Pocono. Records of gas wells drilled in the Smicksburg quadrangle do not indicate red shales at this horizon.

Pocono series.

The oldest rocks exposed in the quadrangle belong to the Burgoon member of the upper part of the Pocono series. About 150 feet are probably above the creek in the gorge above Milton.

Unexposed rocks.

Numerous wells have penetrated the subsurface rocks to depths of more than 3,000 feet. The records show a confusing variation of the strata, few beds being persistent. This is partly due to inaccurate recording by the drillers, but mostly to the lenticular nature of the rocks. The unexposed rocks penetrated belong to the Pocono formation of the Mississippian system, the Catskill facies, "Chemung" and part of the Portage group of the Upper Devonian system. The Lightcap deep well about one mile northwest of Marion Center, starting about 180 feet above the Upper Freeport coal, was drilled to a depth of 7,002 feet. Based on Fetteke's interpretation of the Irwin deep well in the northeastern part of the Punxsutawney quadrangle, the Lightcap well may have reached the Hamilton group and was stopped about 435 feet above where the Oriskany may be expected, if present.

Owing to the limited time for the preparation of this report, a detailed study and identification of the "sands" could not be made, hence the formational boundaries are not definitely determined.

The accompanying section is plotted from wells from northwest to southeast. This method was chosen to give a picture of the variability of the "sands" and to show the relation of the surface and subsurface structure. The generalized section, compiled from many good records, is only tentative, and the names used are those of the drillers. Accepting the names from the Upper Freeport coal to the Snee sand as in accord with the results of studies in the older fields, the Gordon should be in the position of the Gordon stray or immediately under it, and the names of the other sands to the Elizabeth inclusive, moved to correspond. The sands from the First Warren to the Tiona, inclusive, are probably correctly named.

It is now agreed that the First Bradford is the same as the Third Warren, the Second Bradford probably the equivalent of the Tiona and the Third Bradford about in the position here assigned to the First Sheffield. The Balltown sands are now known to be at the horizons of the Speechleys and the Sheffield is either at the horizon of the Tiona or close under it. The sands here called Bradford are doubtless the approximate equivalents of the Lewis Run, Kane, Haskill and others of the Bradford field. The corrected correlations here given are tentative and subject to possible further correction as studies now in progress are continued.*

* See Pennsylvania Geological Survey Bull. M-21, The Bradford Oil Field.

Age	System	Series	Group	Columnar Section	Names of Beds		
Carboniferous	Pennsylvanian	Pittsburgh	Conemaugh (Ccm)		Duquesne coal	375	
					Grafton sandstone	350	
					Ames limestone	325	
					Harlem coal	300	
					Upper Saltsburg sandstone	275	
					Upper Bakerstown coal	250	
					Woods Run limestone	225	
					Lower Saltsburg sandstone	200	
					Lower Bakerstown coal	175	
					Pine Creek limestone	150	
					Buffalo sandstone	125	
					Brush Creek coals and limestone	100	
					Upper Mahoning sandstone	75	
					Mahoning coal and limestone	50	
					Lower Mahoning sandstone	25	
					Upper Freeport coal	0	
					Upper Freeport limestone	25	
					Lower Freeport coal	50	
					Upper Kittanning coal	75	
			Allegheny (Ca)		Middle Kittanning coals	100	
					Lower Kittanning coal	125	
					Vanport limestone	150	
					Clarion coals	175	
					Clarion sandstone	200	
					Brookville coal	225	
					Homewood sandstone	250	
					Connoquenessing sandstone	275	
						300	
						325	
		Pottsville	Cpv			350	
						375	
						400	
						425	

Figure 2—Generalized columnar section of the exposed rocks in the Smicksburg quadrangle

EXPLANATION

Ccm
Conemaugh group

Ca
Allegheny group

Cpv
Pottsville group

UF
Upper Freeport
coal horizon

Bv
Brookville coal
horizon

—1200—
Structure contours
on top of Upper
Freeport coal
Contour interval
50 feet
Datum is mean
sea level



ENGRAVED OCT. 1905 BY U.S.G.S.
Frank Sutton, Geographer in charge
Topography by Wm. O. Tufts and R.H. Reineck.
Control by A.H. Thompson, Geo. T. Hawkins, and Robt. D. Cummin.
Surveyed in 1906-1907.
SURVEYED IN COOPERATION WITH THE STATE OF PENNSYLVANIA.

APPROXIMATE MEAN
DECLINATION 1911

Scale 1:25,000
Miles
Kilometers
Contour interval 20 feet.
Datum is mean sea level.



Edition of Jan. 1908, reprinted 1922.
Polyconic projection, North American datum.

SMICKSBURG

Figure 1—Map of Smicksburg quadrangle showing
geologic structure and formational boundaries

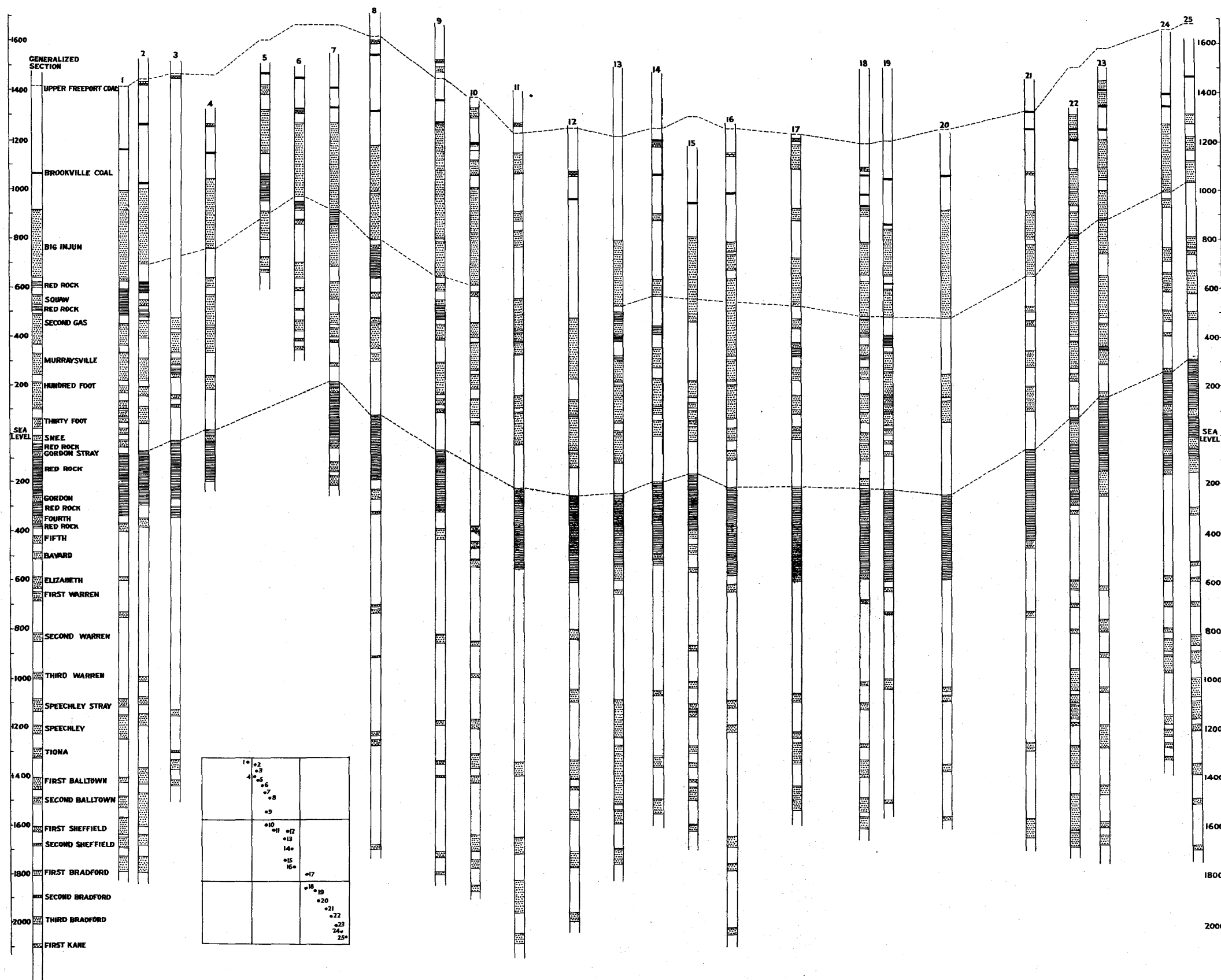


Figure 3—Diagram plotted from well records showing variability of "sands" and the relation of the surface and subsurface structure